Research Issues and Ideas on Health-Related Surveillance

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Summary. In this overview paper, some of the surveillance methods and metrics used in health-related applications are described and contrasted with those used in industrial practice. Many of the aforesaid methods are based on the concepts and methods of statistical process control. Public health data often include spatial information as well as temporal information, and in this and other regards, public health applications could be considered more challenging than industrial applications. Avenues of research into various topics in health-related monitoring are suggested.

1 Introduction

The purpose of this paper is to give an introduction to health-related monitoring, particularly to those more familiar with research in industrial process monitoring. Some of the topics covered by Woodall (2006) are updated. A review of recently published papers, and some still in press, is given. Many of the methods currently used in public health surveillance are based on the concepts of statistical process control (SPC), commonly applied in industry and business. Indeed, Lawson and Kleinman (2005, p. 5) stated, “SPC has formed the basis for many disease surveillance systems.”

There is a growing interest in health-related monitoring and improvement among industrial practitioners. There will be, for example, a special issue on this topic by Quality Engineering. There are many interesting and challenging research problems in public health surveillance and in health-related monitoring. Re-
searchers in industrial statistics are strongly encouraged to consider topics in these areas, a number of which are suggested in this paper.

There are several excellent review papers and books that can be very useful to anyone wanting to know more about health-related monitoring. Sonesson and Bock (2003) and Lawson and Kleinman (2005) provided very helpful reviews of public health surveillance. For more in-depth information, an online journal on public health surveillance topics, *Advances in Disease Surveillance*, can be found at http://www.isdsjournal.org/issue/current.

The discussion by Benneyan (2006) is recommended as a starting point for those interested in hospital applications. Thor et al. (2007) provided a review of the literature of healthcare applications of control charts. Control of infection rates is very important in hospitals, with a recent paper on this topic given by Sherlaw-Johnson et al. (2007). Tennant et al. (2007) reviewed applications of control charts for use with individual patients with chronic diseases such as diabetes and asthma.

The papers by Fienberg and Shmueli (2005), Shmueli and Burkom (2008), Buckeridge et al. (2005), Fricker and Rolka (2006), and Rolka et al. (2007) would be very useful sources for those interested in the very challenging area of syndromic surveillance. In syndromic surveillance data are drawn from a variety of sources, such as emergency room records, over-the-counter drug sales, absenteeism rates, and so forth, in an attempt to supplement traditional sentinel surveillance for natural disease outbreaks or bioterrorist attacks.

### 2 Contrasts between Industrial and Health-Related Monitoring

Some of the differences between industrial and health-related surveillance practice, performance metrics, and research literature are given in this section.

1. **Data:** Attribute data are of greater focus in the health setting than in the industrial setting. For example, in surveillance for outbreaks of disease the incidence rate, or number of new cases in the population of interest by unit of time, is typically monitored. More use is made of observed data, especially in the comparison of aspects of available methods, because of the evolving, non-stationary nature of the data streams and because processes in the health environment cannot be summarily corrected. For instance, rather than adopting a model for normal (non-outbreak) conditions, observed data may be used as testbeds on which to compare competing methods’ ability in detecting simulated outbreak scenarios, despite the fact that effects of actual unknown outbreaks may be present in these datasets. Indeed, there is somewhat of a cultural divide regarding the use of observed data for evaluation of methods in public health surveillance and the use of null models in industrial SPC, a divide discussed by Breiman (2001) in a more general context.

2. **Pattern of Outbreak:** Most industrial control chart methods are studied under the model of a constant baseline parameter, with a sustained step shift in